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Directions for using Lindane Sprays to control Pine Engravers

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The following instructions on the use of the insecticide lindane for controlling pine engravers have grown out of limited research with this chemical in laboratory tests and small-scale experiments. These studies have shown oil solutions of lindane to be very effective against the California five-spined engraver. 1/ No large-scale field trials have been made, but we feel confident lindane will be a satisfactory spray for controlling these bark beetles in practice.

Spray Materials

Lindane is sold either in pure form, that is, 99 percent or better, or as an ingredient of the compound benzene hexachloride, commonly called BHC. BHC thus is a mixture of chemicals, one of which is lindane. The lindane content of BHC is variable: generally between 10 and 30 percent by weight. The amount of lindane in the BHC you buy must be known exactly because the lindane fraction is the only part toxic to insects and is the only part that need be considered when mixing a spray. The amount of lindane in any sample of BHC is clearly marked on the label and is always referred to as "gamma isomer," not "lindane."

The materials needed to formulate the spray are kerosene and lindane or BHC. Any standard kerosene you buy is satisfactory. Some kerosene is further refined and sold as a "deodorized kerosene" under various trade names. It lacks the characteristic kerosene odor but costs more and is not necessary to use.

Lindane and BHC may be purchased in several different forms as follows:

1. Technical lindane or BHC - this is the plain insecticide with nothing added.

2. Oil solution or concentrate - the insecticide is dissolved in an oil solvent with nothing else added.

1/ Lyon, R.L. Lindane, a better insecticide for pine engraver beetles. Calif. Forest and Range Expt. Sta. Misc. Paper 29, 2 pp., illus. February 1959.

3. Emulsifiable concentrate - the insecticide is dissolved in an oil solvent along with another compound called an emulsifier which acts to make the concentrate mix readily with water.

4. Wettable powder - the insecticide is mixed with an inert powder and another compound called a wetting agent which permits the wettable powder to be dispersed or suspended in water.

5. Dust - the insecticide is mixed with or absorbed on an inert powder.

The technical product and oil concentrate (preparations 1 and 2 above) are most suitable. It is least expensive to buy the technical lindane or BHC and kerosene separately. A given amount of lindane is about three times more expensive than the same amount sold as a constituent of BHC so you will want to get BHC where you can.

The emulsifiable concentrate (preparation 3) is less satisfactory because you pay for an expensive emulsifier which is superfluous when the concentrate is to be diluted with oil.

Do not attempt to use a wettable powder or dust (preparations 4 and 5). Both of these materials contain inert powders which will not dissolve in kerosene, but will leave a sludge that can cause much inconvience.

Some California sources 2/ of lindane and BHC are:

California Spray-Chemical Corp.--Fresno, Richmond, Sacramento San Jose, and Whittier.

John Powell and Co., Division of Olin Mathieson Chemical Corp.--Fresno.

Niagara Chemical Division, Food Machinery and Chemical Corp.--Richmond.

Pennsalt Chemicals Corp.--Berkeley and Los Angeles.

Stauffer Chemical Co.--Berkeley, Los Angeles, and San Francisco.

Mixing the Spray

The finished spray must be a 0.2 percent solution of lindane (as lindane or as gamma isomer of BHC). This concentration is composed

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2/ Mention of companies or products does not imply endorsement, nor does it imply criticism of similar items not mentioned.

of 1 part lindane and 500 parts kerosene by weight. The amount of material to use in making a spray mixture of the proper concentration depends upon the form in which the lindane is obtained.

If you use the dry technical insecticide, the correct amounts required to add to 14 gallons of kerosene are:

Compound and percent gamma isomer	Amount in ounces
Lindane --	3
BHC 10	32
BHC 12	27
BHC 15	21
BHC 17	19
BHC 20	16
BHC 25	13

These amounts will make 14 gallons of a 0.2 percent lindane solution--enough to treat 6 trees, 24 inches in diameter.

When liquid concentrates are used it is easier to measure the amounts of concentrate and kerosene in parts by volume. The correct proportions for a 0.2 percent lindane solution are:

Percent lindane or gamma isomer in concentrate:	Parts kerosene to add to 1 part concentrate
5	21
10	43
12	52
15	65
20	87
25	109

It is least expensive to buy the technical insecticide and kerosene separately and mix them yourself. The insecticide dissolves slowly in kerosene, but warming the solution will speed the process. Do not use on open flame. Keep the temperature below boiling. A convenient rule is to heat only so the kerosene is not too hot to put your finger in but too hot to leave it there.

The insecticide concentrates are more expensive but offer the added convenience that they readily mix with kerosene without heating. You may also buy the insecticide and the auxiliary solvent separately and mix your own concentrate. Your insecticide dealer can give you specific information about these materials.

Insecticide Sprayer

Use a portable, compressed air sprayer of the type that can be pumped up by hand. The capacity of the sprayer should be between 1 and 5 gallons. The 3-gallon size is probably most convenient. Be

sure that the sprayer is designed for use with oil solutions. Some portable sprayers can be conveniently slung on the back while in use.

Use a nozzle producing a cone-shaped spray, and a nozzle orifice having a diameter of about 1/32 inch. This produces a fine spray but not a mist. Too large an orifice will deliver too much spray so that the amount applied will always be excessive. Too fine an orifice will produce a mist of very small droplets that will be deflected from the bark and lost as drift. In both cases, spray is wasted and material costs are increased. Do not overpressurize the sprayer for the spray will then be delivered with such force that most of it will bounce off the bark.

Preparation of the Infested Tree

Normally trees to be treated will need to be felled. The tree should be felled on an irregular surface, if possible, so that most of the trunk is clear of the ground. Then the spray can be applied to the underside of the bole as well as to the top and sides. The limbs themselves may serve to hold the tree off the ground. These supporting limbs should be left on the tree.

Small standing trees can be sprayed with a power sprayer if equipment is available that can reach all the infested bark.

Spraying Procedure

Apply the spray very lightly to all the bark surface. The amount to apply can best be judged by stopping when the bark looks wet. This will require very little spray, and you will find that the nozzle must be passed rapidly over the bark to avoid depositing an excessive dose. Hold the nozzle 1 to 2 feet from the bark surface.

Lindane as a Protective Spray

Lindane also promises to be effective in preventing bark beetle attacks on slash and standing trees. Though we have no experimental evidence to show that it works, we feel it merits a trial in the absence of other protective measures.

For both slash and green standing trees, the same formula should be used. Again, the spray should be applied until the bark is just wet. With green standing trees, care should be taken to avoid getting spray on the foliage. The foliage can be burned by the spray and can be killed by heavy doses.

Before a protective spray is applied, examine the tree closely to make sure that beetles have not already attacked it. Trees cannot be protected once they have become infested. The foliage of a pine tree infested with bark beetles goes through various color phases--from a straw color to a reddish brown. As soon as the foliage becomes straw colored, the tree is for all practical purposes dead and cannot be saved by a protective spray. Even if the foliage is green, the tree is beyond protection if infested with early stages of bark beetles.

Added protection of living trees can be had by applying repeat sprays every 4 to 6 months as long as bark-beetle-killed trees continue to show up in the vicinity of the trees to be protected. Slash will probably need only one spraying to keep it from becoming infested because it will probably dry out and become unattractive to bark beetles before the protective effects of the spray are lost.

> **CAUTION:** Lindane is a poison. Read carefully all directions on the container. The mixture of lindane and kerosene recommended has the flammability of kerosene alone and must be handled with the same precautions taken to avoid fires with kerosene.